A B S T R A C T

[Abstract of the Disclosure]

There are provided a method of managing a defect in a write-once recording medium. The method includes: (a) determining whether to perform defect management when the write-once recording medium is loaded to record data thereon; (b) if it is determined not to perform defect management, initializing the write-once recording medium after recording initialization information indicating defect management is not to be performed in a TDMA; and (c) if a command of finalizing the write-once recording medium is input, recording temporary recording information recorded in the TDMA in a DMA. In the method of managing defect in the write-once recording medium according to the present invention, a defect management of the write-once recording medium by a drive can be selectively performed, and compatibility can be provided so that data can be recorded on or read from the write-once recording medium in a drive for rewritable information storing medium.

[Representative Drawing]

FIG. 1

S P E C I F I C A T I O N

[Title of the Invention]

Method of managing defect in write-once recording medium

[Brief Description of the Drawings]

FIG. 1 is a state diagram of a write-once recording medium according to the present invention;

FIG. 2 is a data structure diagram of a single recording layer recording medium according to the present invention;

FIG. 3 is a data structure diagram of a double recording layer recording medium according to the present invention;

FIG. 4 is a data structure diagram of a write-once recording medium having a single recording layer according to the present invention; and

FIG. 5 is an exemplary view of a TDDS and a SMB recorded in a single block according to the present invention.

[Detailed Description of the Invention]

[Object of the Invention]

[Technical Field of the Invention and Related Art prior to the Invention]

The present invention relates to a method of managing a defect in a write-once recording medium.

Defect management involves re-writing user data, which has been recorded in a user data area where a defect is generated, thereby compensating for data loss caused by generation of the defect. Conventionally, defect management is classified into defect management using linear replacement and that using slipping replacement. Linear replacement is to replace an area of a user data area where a defect is generated with an area of a spare area provided in the data area where a defect is not

generated. Slipping replacement is to slip the area where a defect is generated without using such an area and use a next area where a defect is not generated.

Rerecording on, for example, a DVD-RAM/RW is possible using the linear replacement and the slipping replacement, and they are frequently adopted in discs that can be recording using a random access method.

Recently, methods of configuring defect management using a drive are researched even for write-once recording media in which data cannot be overwritten once data is recorded.

[Technical Goal of the Invention]

The present invention provides a method of managing a defect in a write-once recording medium using a drive.

[Structure of the Invention]

According to an aspect of the present invention, there is provided a method of managing a defect in a write-once recording medium, the method comprising: (a) determining whether to perform defect management when the write-once recording medium is loaded to record data thereon; (b) if it is determined not to perform defect management, initializing the write-once recording medium after recording initialization information indicating defect management is not to be performed in a TDMA; and (c) if a command of finalizing the write-once recording medium is input, recording temporary recording information recorded in the TDMA in a DMA.

Preferred embodiments of the present invention will now be described with reference to the attached drawings.

A write-once recording medium includes a defect management area (DMA) and a temporary defect management area (TDMA) and a spare area (SA) for replacing a defect block in case a defect is generated. The DMA is composed of a disc definition structured (DDS) for the defect management information and a defect list (DFL) for the defect information, and is provided for compatibility with rewritable recording media or to

record defect information recorded in a final TDMA during finalization. The TDMA is composed of a temporary disc definition structure (TDDS) for temporary defect management information, a space bit map that indicates recording or non-recording in blocks of a physically available space of a disc using bit values, and a temporary defect list (TDFL) for the temporary defect information. Also, the write-once recording medium may or may not perform defect management using a drive according to a selection of a user or a disc drive manufacturer. According to a preferable embodiment of the present invention, a method of managing a defect in a write-once recording medium is described using a state diagram of the write-once recording medium described above.

FIG. 1 is a state diagram of a write-once recording medium according to the present invention.

Referring to FIG. 1, the state of the write-once recording medium and the state change operations will be described.

Empty disc 10 refers to a blank disc on which data is not recorded, and state 20 indicates a state in which nothing is recorded in a DMA and a TDMA is in a state in which update can be performed, after initialization to a DM-on mode.

State 30 indicates a state in which the TDMA is updated into a write with DM. State 40 indicates a state of the disc after re-initialization due to size change of the spare area.

State 50 indicates a state in which a final TDDS and TDFL information are recorded as DDS and DFL information in the DMA, the TDDS and SBM are recorded in the TDMA with flag information indicating finalization, and values such as “FFh” is recorded in the rest of the area (i.e., the rest of TDMA) in which the SBM can be recorded, by a finalization command in the DM-on mode.

State 60 indicates a state in which nothing is recorded in the DMA and the TDMA is in a state in which update can be performed, as in state 20 described above.

State 70 indicates a state in which the TDMA is updated into a write without DM.

The write-once recording medium described above requires initialization, re-initialization, and finalization, or is updated in operation units. Such an operation may be one verify-after-write unit or a plurality of verify-after-write units in which a block is recorded and then verified, or eject units. The block means an error correction code (ECC) unit recorded in the disc.

The term “DM-on mode” refers to assigning a spare area in the data area by the intensions of the user or the drive manufacturer, and recording the data in a recording medium while defect management is performed on the recording medium.

The term “DM-off mode” refers to not assigning a spare area in the data area by the intensions of the user or the drive manufacturer, and recording the data in a recording medium without performing defect management on the recording medium.

The term “re-initialization for SA change” refers to changing the size of the spare area and then recording information regarding the change in the disc if the spare area for replacing defect generated while using the disc after initialization is entirely consumed and the spare area needs to be enlarged, or the spare area needs to be reduced due to lack of area for the user data area.

The term “write with DM” refers to recording data while defect management is performed by the drive, and the term “write without DM” refers to recording the data without performing the defect management by the drive.

The term “finalization” refers to the finalization operation of the recording medium.

Referring to FIG. 1, a method of managing a defect of a write-once recording medium according to the present invention will be described in more detail.

When the recording medium is loaded into a drive, the drive recognizes whether the recording medium is identifies the loaded disc, i.e., identifies the type of the loaded disc, whether the loaded disc is recordable, and whether the loaded disc is already used, using information stored in the loaded disc. If the drive identifies the loaded write-once recording medium as an empty disc as in step 10, the drive performs an initialization process according to a command of a user or the intention of a drive manufacturer.

When the user or the drive manufacture desires to perform defect management by the drive, that is, when the empty disc 10 is changed to the initialization for DM-on mode in FIG. 1, the drive records initialization information inducing information needed for defect management by the drive as the TDDS information of the TDMA in the recording medium.

Such initialization information may include the size and location information of the spare area in the data area, and information on areas where the user data can be recorded.

State 20 indicates a state of the disc after initialization in which the DMA is empty and information can be updated in the TDMA.

In state 30, the drive records data through the verify-after-write procedure for defect management by a recording command of a host connected to the drive after the initialization. Then, the drive updates information in operation units if the TDDS, the space bit map, and the TDFL recorded in the TDMA need to be updated as the data is recorded.

When all of the spare area for replacing the defect block is consumed when a defect is generated in the recording medium in state 30, if the spare area needs to be enlarged because it is determined that the additionally generated defect blocks cannot be replaced, or the spare area needs to be reduced due to lack of space to record the user data, the drive changes the size of the spare area according to the command of the host or the intentions of the disc manufacturer, and recording the re-initialized information in the recording medium

In more detail, if the finalization command is received from the user while continuing to record in the DM-on mode after changing the state of the recording medium to state 40 by the re-initialization for SA change recorded in the TDDS to state 40, the finalized TDDS and TDFL are recorded respectively as DDS and DFL information in the DMA for compatibility with the rewritable recording medium, a “finalization flag = 1” is recorded in the SBM indicating that the disc is finalized, and

specific values are recorded in the rest of the remaining area in which SBM can be recorded so that SBM is not changed.

The same operation is performed when the finalization command of the user is received while in state 30 without having to go through state 40. The final state the user intended can be known using the SBM information, which is the final "finalization flag = 1", even if the state of the recording medium changes after initialization since the SBM indicates the final recording state of the recording medium. In addition, it can be known that the state of the recording medium has changed.

The state of the recording medium becomes from state 30 to state 60 when converting into the re-initialization for DM-off mode in which the TDDS and TDFL information are respectively recorded as the DDS and DFL information in the DMA for compatibility with the rewritable recording medium, or when indenting to record in the initialization for DM-off mode according to the intensions of the user or the drive manufacturer during initialization.

The data is recoded in write without DM for compatibility with the rewritable recording medium in state 70. When the finalization command of the user is received while recording in the write without DM in state 70, a "finalization flag = 1" indicating that the recording medium has been finalized is recorded in the TDDS or the SBM, and specific values are recorded in the rest of the area in which the SBM can be recorded so that the SBM cannot be further updated.

The write-once recording medium for managing a defect according to the present invention will be described below.

FIG. 2 is a data structure diagram of a single recording layer recording medium according to the present invention, and FIG. 3 is a data structure diagram of a double recording layer recording medium according to the present invention.

In the single recording layer recording medium illustrated in FIG. 2, a lead-in area, a data area, and a lead-out area are provided in succession. A spare area 1 and a spare area 2 are provided in the data area.

In a double recording layer recording medium illustrated in FIG. 3, a recording layer L0 includes an inner area 0, a data area 0, and an outer area 0 in succession from inner to outer circumference of a disc, and a recording layer L1 includes an outer area 1, a data area 1, and an inner area 1 from outer to inner circumference of the disc. A spare area 1 and a spare area 2 are included in the data area 0, and a spare area 3 and a spare area 4 are included in the data area 1.

FIG. 4 is a data structure diagram of a write-once recording medium having a single recording layer according to the present invention.

In a single layer rewritable recording medium in which a lead-in area, a data area, and a lead-out area are sequentially provided, a DMA, a recording condition test area, a drive information area are included in at least one of the lead-in area and the lead-out area, and one or a plurality of spare areas for replacing a defect when the defect is generated and a user data area are included in the data area.

In order to configure a defect management in the write-once recording medium performed by the drive, a TDMA is additionally required besides having the structure as the rewritable recording medium. This is because of the characteristics of the write-once recording medium where data cannot be overwritten when desiring to update certain information, unlike a rewritable recording medium, and thus requires a new area. More areas are required as the number of updates increases.

Generally, the DMA in the rewritable recording medium is not that large. As a result, in the write-once recording medium, the TDMA may be separately provided so as to be compatible with the rewritable recording medium, or the final TDDS and the TDFL information can be recorded as the DDS and DFL information in the DMA during finalization so as to be compatible with the rewritable recording medium.

In the write-once recording medium in which the lead-in area, the data area, and the lead-out area used for defect management by the drive are provided in succession, a DMA, a recording condition test area, a drive information area are included in at least one of the lead-in area and the lead-out area, and one or a plurality of spare areas for

replacing a defect when the defect is generated and a user data area are included in the data area.

In the single layer rewritable recording medium for managing a defect according to the present invention illustrated in FIG. 4, a DMA, a TDMA, a recording condition test area, and a drive information area are provided in the lead-in area, and two spare areas for replacing a defect when the defect is generated and a user data area are provided in the data area.

The TDMA includes a TDDS, a space bit map, and a TDFL. The TDDS is temporary defect management information, and includes a TDFL pointer, a drive information pointer, a recording condition test available location pointer, a finalization flag, a defect management (DM) mode, a write protection, a spare area size, a recording mode, and user data area location information.

The space bit map is an information map showing recording or non-recording in blocks of a physically recordable space of a disc in bit values, and includes header information and bit map information. The TDFL includes header information and a defect entry. The defect entry includes state information, a defect block's physical address, and a replacement block's physical address.

Particularly, in case of a continuous defect, whether or not the defect entry is a start defect entry or an end defect entry can be known using the state information. When the defect entry is the start defect entry, a physical address of the defect block and the physical address of the replacement block may indicate the start of blocks that are continuously replaced as a continuous defect is generated, and when the defect entry is the end defect entry, a physical address of the defect block and the physical address of the replacement block may indicate the start of blocks that are continuously replaced as a continuous defect is generated. When recorded as TDFL information, the defect entry may be recorded directly after the start defect entry.

The state information may also indicate that the defect entry only includes information on the block in which a defect is generated without a replacement. In this case, the physical address of the replacement block does not have any meaning.

The write-once recording medium as described above requires initialization, re-initialization, and finalization, or is updated in operation units. The operation units may be once or a plurality of verify-after-write units which verifies after recording a predetermined block, or eject units.

In the present embodiment, when updating the TDDS, the space bit map, and the TDFL, the TDDS and the SBM are recorded in the same block, and the TDFL is recorded in a different block.

FIG. 5 is an exemplary view of a TDDS and a SMB recorded in a single block according to the present invention.

During initialization for DM-on mode, the information on the size of the spare areas 1 and 2 assigned, the start and end location information of the user data area are recorded in the TDMA as TDDS + SBM information. During initialization for DM-off mode, the size of the spare areas 1 and 2 that are not assigned are set as “0” and the start and end location information of the user data area are recorded in the TDMA and the DMA.

When the size of the spare area changes due to re-initialization for SA change in the DM-on mode, the size of the spare areas 1 and 2 of the TDDS are changed accordingly and then recorded as TDDS in the TDMA.

When the finalization command from the user is received during the DM-on mode, the drive records the final TDDS and TDFL information in the DMA as DDS and DFL information, sets “finalization flag = 1” among the contents of the TDDS and records it together with the final SBM in the TDMA, and fills the rest of the TDMA area with values such as “FFh” so that no more SBM can be recorded.

When the finalization command from the user is received during the DM-off mode, the drive sets “finalization flag = 1” among the contents of the TDDS and records it together with the final SBM in the TDMA, and fills the rest of the TDMA area with values such as “FFh” so that no more SBM can be recorded.

[Effect of the Invention]

As described above, a method of managing a defect in a write-once recording medium according to the present invention enables selective performance of a defect management of the write-once recording medium by the drive, provides compatibility with a rewritable recording medium by enabling reproducing of data recorded in the write-once recording medium even in a drive for a rewritable recording medium, and improves practical use of the write-once recording medium by enabling the size of a spare area defined during initialization to be changed through re-initialization for defect management.

What is claimed is:

1. A method of managing a defect in a write-once recording medium, the method comprising:

(a) determining whether to perform defect management when the write-once recording medium is loaded to record data thereon;

(b) if it is determined not to perform defect management, initializing the write-once recording medium after recording initialization information indicating defect management is not to be performed in a TDMA; and

(c) if a command of finalizing the write-once recording medium is input, recording temporary recording information recorded in the TDMA in a DMA.